

Positive and "Enriched" Environments Reverse Traumatic Stress and Reshape Epigenetic Signature of Spermatozoa and Ovulation

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In evolutionary theories (Lamarckian and Darwinian), environment and physical changes could be transmitted to the descendants (1). Psychological factors in human beings (2–4) have a negative impact on the germ cells parameters (5). As time goes on, the quality of sperm is deteriorating (5, 6) as well as humanocyte/egg (7).

A simple change of environment and environmental preconceptional exposure (*i.e.*, diet, physical activity, smoking, alcohol consumption, *etc.*) affects the functioning of the genes and the phenotype of the next generation through remodeling epigenetic blueprint of spermatozoa (8, 9). Lifestyle and environmental factors influence the sperm and egg which will affect subsequent generations (10–12). Some studies have examined the transmission of specific behavioral and structural adaptations in relation to the stimulus in the nervous system, from parents to their offspring (10, 13).

Effects of psychological and environmental factors on gene expression persist even after the removal of the inducing agent passed on to subsequent generations (14). So, Genetic Memory can be contemplated in two ways (Biology and Psychology) (10, 15).

Psychological factors which have the impact on fertility are treated in numerous studies on humans (5, 16–18) as psychological stress (7). The life of wars and prisons has an effect on germ cells (Sperm, menstrual irregularity and reproductive function) (7, 19, 20). Men who suffered from anxiety and depression or who have experienced high levels of stress had long-term sperm damage. Stress affects sperm quality over the long term, even slowing down the mental development of off

spring. This stress is transmitted from one generation to another and has other perverse effects (21).

Sperm of obese men have a distinct epigenetic signature compared to lean men. The methylome of spermatozoa is dynamically remodeled after weight loss (22). Paternal nutritional status can directly affect the health of offspring (21, 23), suggesting that an epigenetic inheritance phenomenon acquired by the environment is transmitted by gametes (22). Environmental factors as exercise and nutritional status induce acute changes in DNA methylation profiles in human skeletal muscle and adipose tissue (24–28) demonstrating that environmental factors are reshaping the epigenome of somatic tissues (22).

The fertility of humans is impacted by myriad factors (Stress, obesity, alcohol and tobacco, seasonal variations, *etc.*) (28, 30). "Licking" (31), sense of touch and massage can be a great stress reliever, and is very important to emotional health (32), and sexual desire and performance (33). Scientists have found that the process of "Traumatic stress, *etc.*" can be reversed if mice from traumatized lineages are put in "Enriched" environments (34). Psychotherapy could improve psychological and environmental factors and make the environment more positive and richer (35).

Scientists have reached several conclusions by researching humans; the trauma would thus modify the behavior of the traumatized individual but also those of his descendants since one finds a metabolic modification until the third generation. This would mean that trauma also affects germ cells (Spermatozoa and ova) which are the only biological link between generations (34). A positive and nurturing environment help humans with-

stand the threat (34, 36). The decrease in anxiety (37), improvement of psychological factors (38) with reduced vulnerability to stress factor and shocks (39) are related to bgetting a pregnancy (5).

Negative psychological and environmental factors, war, nutritional status, seasonal variations, physical and social environmental factors and stress have many negative consequences and effects on the germ cells. "Enriched" and positive environments can reverse these factors and have positive consequences on the germ cells in individual that could be transmitted to their off spring.

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Conflict of Interest

The author declares that he has no competing interest. Author has not received the financial support for research.

References

- Lamarck J. [Influence of circumstances on animal actions (5th lesson)]. Muséum National d' Histoire Naturelle de Paris. French.
- Brkovich AM, Fisher WA. Psychological distress and infertility: forty years of research. *J Psychosom Obstet Gynaecol.* 1998;19(4):218-28.
- Vellani E, Colasante A, Mamazza L, Minasi MG, Greco E, Bevilacqua A. Association of state and trait anxiety to semen quality of in vitro fertilization patients: a controlled study. *Fertil Steril.* 2013;99(6):1565-72.
- Wright J, Duchesne C, Sabourin S, Bissonnette F, Benoit J, Girard Y. Psychosocial distress and infertility: men and women respond differently. *Fertil Steril.* 1991;55(1):100-8.
- Zorn B, Virant-klun I, Kolbezen M, Velikonja V, Meden-Vrtovec H. [Psychological stress and sperm quality in 450 infertile Slovenian men.] *Andrologie.* 2001;11(2):76-85. French.
- Auger J, Kunstmann JM, Czyglik F, Jouannet P. Decline in semen quality among fertile men in Paris during the past 20 years. *N Engl J Med.* 1995;332(5):281-5.
- Abu-Musa AA, Kobeissi L, Hannoun AB, Inhorn MC. Effect of war on fertility: a review of the literature. *Reprod Biomed Online.* 2008;17 Suppl 1:43-53.
- Donkin I, Barrès R. Sperm epigenetics and influence of environmental factors. *Mol Metab.* 2018;14:1-11.
- Jablonka E, Lamb MJ. Evolution in four dimensions: genetic, epigenetic, behavioral, and symbolic variation in the history of life. 1st ed. Cambridge, Mass: MIT Press; 2005. 462 p.
- Namazi H. Can we explain the memory transfer between generations by mathematical analysis of DNA walk? *ARC J Neurosci.* 2017;2(2):1-3.
- Dias BG, Ressler KJ. Parental olfactory experience influences behavior and neural structure in subsequent generations. *Nat Neurosci.* 2014;17(1):89-96.
- Lim JP, Brunet A. Bridging the transgenerational gap with epigenetic memory. *Trends Genet TIG.* 2013;29(3):176-86.
- Stickrod G, Kimble DP, Smotherman WP. In utero taste/odor aversion conditioning in the rat. *Physiol Behav.* 1982;28(1):5-7.
- Turner BM. Epigenetic responses to environmental change and their evolutionary implications. *Philos Trans R Soc B Biol Sci.* 2009;364(1534):3403-18.
- Gallistel R, Pashler H. Learning, motivation, and emotion. 3rd ed. New York, NY: Wiley; 2002. 900 p.
- Bigelow PL, Jarrell J, Young MR, Keefe TJ, Love EJ. Association of semen quality and occupational factors: comparison of case-control analysis and analysis of continuous variables. *Fertil Steril.* 1998; 69(1):11-8.
- Gerhard I, Lenhard K, Eggert-Kruse W, Runnebaum B. Clinical data which influence semen parameters in infertile men. *Hum Reprod Oxf Engl.* 1992;7(6):830-7.
- Giblin PT, Poland ML, Moghissi KS, Ager JW, Olson JM. Effects of stress and characteristic adaptability on semen quality in healthy men. *Fertil Steril.* 1988;49(1):127-32.
- Bass F. [Amenorrhea at Terezin Concentration Camp (Theresienstadt)]. *Gynaecologia.* 1947;123(4):211-9. French.
- Whitacre FE, Barrera B, Briones TN. WAR amenorrhea: a clinical and clinical laboratory study. *J Am Med Assoc.* 1944;124(7):399-403.
- Rodgers AB, Morgan CP, Bronson SL, Revello S, Bale TL. Paternal stress exposure alters sperm microRNA content and reprograms offspring HPA stress axis regulation. *J Neurosci.* 2013;33(21): 9003-12.
- Donkin I, Versteyhe S, Ingerslev LR, Qian K, Mechta M, Nordkap L, et al. Obesity and bariatric

- surgery drive epigenetic variation of spermatozoa in humans. *Cell Metab.* 2016;23(2):369-78.
23. Marsit CJ. Influence of environmental exposure on human epigenetic regulation. *J Exp Biol.* 2015;218 (Pt 1):71-9.
 24. Nestler EJ, Barrot M, DiLeone RJ, Eisch AJ, Gold SJ, Monteggia LM. Neurobiology of depression. *Neuron.* 2002;34(1):13-25.
 25. Walker E, Mittal V, Tessner K. Stress and the hypothalamic pituitary adrenal axis in the developmental course of schizophrenia. *Annu Rev Clin Psychol.* 2008;4:189-216.
 26. Brown AS. The environment and susceptibility to schizophrenia. *Prog Neurobiol.* 2011;93(1):23-58.
 27. Hultman CM, Sandin S, Levine SZ, Lichtenstein P, Reichenberg A. Advancing paternal age and risk of autism: new evidence from a population-based study and a meta-analysis of epidemiological studies. *Mol Psychiatry.* 2011;16(12):1203-12.
 28. Patterson PH. Maternal infection and immune involvement in autism. *Trends Mol Med.* 2011;17 (7):389-94.
 29. Levitas E, Lunenfeld E, Weisz N, Friger M, HarVardi I. Seasonal variations of human sperm cells among 6455 semen samples: a plausible explanation of a seasonal birth pattern. *Am J Obstet Gynecol.* 2013;208(5):406.e1-6.
 30. Hall E, Burt VK. Male fertility: psychiatric considerations. *Fertil Steril.* 2012;97(2):434-9.
 31. Weaver IC, Cervoni N, Champagne FA, D'Alessio AC, Sharma S, Seckl JR, et al. Epigenetic programming by maternal behavior. *Nat Neurosci.* 2004; 7(8):847-54.
 32. Ditzen B, Neumann ID, Bodenmann G, von Dawans B, Turner RA, Ehlert U, Heinrichs M. Effects of different kinds of couple interaction on cortisol and heart rate responses to stress in women. *Psychoneuroendocrinology.* 2007;32(5):565-74.
 33. Bendas J, Georgiadis JR, Ritschel G, Olausson H, Weidner K, Croy I. C-Tactile mediated erotic touch perception relates to sexual desire and performance in a gender-specific way. *J Sex Med.* 2017;14(5): 645-53.
 34. Mansuy I. [conference of Inheritance trauma]. [Internet]. France. Institut Français d'EMDR; 2014. [Cited 2017-01-13]. Available from: <https://www.ifemdr.fr/conference-traumatismes-en-heritage/>
 35. Alsaleh M, Lebreuilly R, Tostain M, Lebreuilly J. [The power of repeating phrases of positive thoughts (RPPT): An effective treatment tool against psychological disorders (depression, anxiety and stress). A controlled and randomized pilot study]. *Ann Méd Psychol Rev Psychiatr.* 2018;176(5):388-447. French.
 36. Alsaleh M, Kubitary A. Verdicts of water drop-sTRPPT on brain and life new frontiers in neuro cognitive positive psychotherapy in war and peace, normal-abnormal-medical-non-medical conditions. 1st ed. SIA OmniScriptum Publishing, Lettonie, Union européenne: Éditions universitaires européennes; 2017. 92 p.
 37. Harlow CR, Fahy UM, Talbot WM, Wardle PG, Hull MG. Stress and stress-related hormones during in-vitro fertilization treatment. *Hum Reprod.* 1996;11(2):274-9.
 38. Sanders KA, Bruce NW. A prospective study of psychosocial stress and fertility in women. *Hum Reprod.* 1997;12(10):2324-9.
 39. Facchinetti F, Matteo ML, Artini GP, Volpe A, Genazzani AR. An increased vulnerability to stress is associated with a poor outcome of in vitro fertilization-embryo transfer treatment. *Fertil Steril.* 1997;67(2):309-14.